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soil. The former explains the method of handling home-made manure, while the latter has to do with commercial fertilizers only. Fig. 31 shows a 'common type of barnyard,' in which home-made fertilizers are allowed to go to waste, while in Fig. 30 is shown a model method of protecting them; yet the position of the watering trough is not an ideal one, looking at it from a sanitary point of view. Fig. 32 shows a 'handy and economical stable,' which, in reality, is anything but desirable. It might do for a makeshift while refitting an old barn, but it cannot be recommended to anyone who is planning to erect a new set of buildings.

Other chapters deal with plants, their propagation and subsequent care. It is misleading to say that germs or bacteria may cause constitutional troubles in the plant, as is done on page 167 and again on page 170, where we read that constitutional diseases are usually treated by burning the affected parts, which implies that such a plant may spread the disease if not destroyed. It is hard to see how a disease inherent in a plant (constitutional) can spread the disease to other plants, unless the affected parts of the diseased plant are used for propagation. Bacterial diseases may affect the internal structure of the host, although 'the cause of it is not apparent on the exterior,' yet such diseases are not constitutional any more than the diseases caused by the *Peronosporiaceæ*. Some biologists deny that there are any true constitutional diseases, while here we have constitutional diseases treated as something different from contagious diseases, but what that something is is not very clear.

The life-history of one parasitic fungus given in detail would have been a valuable addition, for it would have helped much to explain *why* it is that one plant can cause sickness in another, a fact which is hard for any person to understand who has not viewed microscopic preparations of fungi. In doing this the author would have followed out the aim 'to seek why before seek how,' as stated on page 15.

Contact insecticides is a better term than 'caustic insecticides,' for in many cases the insecticide clogs the breathing pores and causes death by suffocation rather than by caustic action on the tissues. Figs. 70 and 71 pretend to

show sucking and biting insects respectively, but the reader will not be able to see the distinction from the illustrations.

Many farmers would think twice before following the advice on page 187: "If the meadow fails to return two tons of field-dried hay to the acre, plow it up," for there are local conditions where less than two tons per acre may be a justifiable crop.

Chapter XIV., 'How the Animal Lives,' by Professor Law, and Chapter XV., 'The Feeding of Animals,' by Professor Wing, give summaries of our present knowledge of subjects of which our farmers, as a rule, do not know nearly so much as they should.

The last chapter, on the 'Management of Stock,' is by Professor Roberts. On page 266 he says that there are two theories respecting the number of animals to be kept on a farm. The fact is we are beyond the theory stage in this matter, and it can be said curtly that there are two methods, the practice of either one of which must depend upon local conditions.

The severest criticism to be made of the book is that nearly every subject discussed in it is treated in too brief a manner, a result inevitable in trying to expound the principles of agriculture in one book of only 300 small pages, printed in large type. This defect has been partially remedied by references to other literature for further study, although it is to be regretted that these references are confined mainly to the work of the editor's immediate associates. The arrangement of the contents is excellent, and on the whole the book is superior to any of its kind.

In closing, we quote again from the preface: "Agriculture is a business, not a science. * * * Business cannot be taught in a book like this; but some of the laws of science as applied to farm management can be taught."

ELISHA WILSON MORSE.

Elementary Zoology. By FRANK E. BEDDARD. New York, Longmans, Green & Company. 1898. 12mo. Pp. vi+208. 93 illustrations.

Every teacher examines with interest any new text-book dealing with the subject in which he gives instruction, and his interest is all the greater if the book is written by a recog-

nized authority and published by a reputable firm. He may find that the book treats the subject in a more satisfactory manner than the text he has been using, and hence be led to change. Or, if he cannot adopt the new book, he may learn from it much that is inspiring and suggestive of better methods of teaching. There are far too many teachers, however, who, having to give instruction in several subjects, have not become especially proficient in any one and are not fitted by experience and training to be competent judges of the merits of different texts. Zoology is one of those studies which are usually 'lumped' together and put into the hands of the 'teacher of science,' who, more often than not, is a physicist or a chemist by training and, consequently, not likely to be qualified to select a good text-book in zoology. Too often is the choice determined by the scientific reputation of the author, who may be of undisputed ability as an investigator, but not successful in his method of presenting his subject; or by the business enterprise of the book agent. Hence, it behooves those who are interested in raising the grade of instruction in the different scientific branches to exercise a careful watch to prevent, if possible, the introduction of text-books, and especially such as are elementary, which are faulty in method and inaccurate in the statement of facts. There is no reason why a new text-book should be issued unless it present the subject by a better method and be a distinct advance over those already published.

This elementary zoology "contains an account of a few types selected from the chief groups of the animal kingdom, followed and accompanied by a consideration of some of the more general conclusions of biology." The author adopts the very commendable plan of treating the types in the ascending order, beginning with a discussion of protoplasm and the amœba. The fifteen chapters of the book deal with the unicellular animals; hydra; earthworm; crayfish; cockroach; metamorphoses of insects; pond mussel; snail; frog; skeletal and integumentary structures of vertebrates; the egg, sperm, and development of the chick; morphology of organs; morphology of tissues; classification; classification of animals. The most of these topics are discussed with a toler-

able degree of clearness, although paragraphs are not infrequent which must be read more than once before the meaning is grasped.

It is questionable whether an average high-school pupil could comprehend the author's treatment of the morphology of the skull and the development of the chick. The first cannot be understood without much elaborate dissection and comparison of specimens, nor the second without the use of sections, and the reconstruction of the latter either into a model or in the imagination is not within the capacity of the beginner.

There are so many grammatical and typographical errors that one is forced to believe that the book was carelessly written and hastily printed. For instance, a singular verb is not infrequently burdened with a plurality of subjects. The unbiased reader has his choice between 'spermatical' and 'spermathecal' pores in the earthworm. Hydra is figured as containing 'interstitial' cells and 'chromatophores,' and anodon as having a 'coelome.' Several figures, *e. g.*, 8 and 9, do not tally with their descriptions. Modifications of Maupas' figures of the conjugation of vorticella are given, but no description of the process accompanies them. The directions for preparing dissections are not always accurate. On p. 23 it is stated that 'when an earthworm is opened by a median incision along the back, and the flaps of skin turned back, the entire anatomy is revealed.' The student will find it necessary to do more than this before he will discover the nervous system. Again, on p. 63, 'when the mantle flap of one side is removed the structures shown in Fig. 29 are brought into view.' The pupil who accepts this statement in good faith will look in vain for the liver, pedal ganglion, connectives and commissures shown in the illustration. An anodon shell with the lines of growth running 'parallel with the long axis of the shell' (p. 62) would be a prize for any conchologist. The explanation of the gaping of the mussel shell after death (p. 62) has the advantage of novelty, if not of verity. It is interesting, too, to learn that the snail is a symmetrical animal, that its radula bears calcified teeth (p. 68) and that the blue color of its blood is due to the presence of 'hæncyanin,' p. 70.

English frogs have the tongue 'bifid at the tip,' and breathe in an uncommonly awkward manner. "When the frog breathes it fills the mouth with air; the mouth is then closed and the external nares, while the muscles forming the floor of the mouth force the contained air into the lungs" (p. 80). In the tadpole, respiration is carried on by a 'free flow of oxygen containing water over the gills.' The adult frogs are said to have 'two first vertebrae,' from which the student infers that they are double-headed. On p. 103 the author says: "The skeleton of the fore limb consists of the pectoral girdle and of the limb which articulates with it." The student is left to wonder which of the two limbs enjoys this distinction and why the other is not equally favored.

Nothing is said about geographical distribution; sponges are nowhere mentioned; in the chapter on histology there is no figure or description of bone, no figure of nerve cells or fibers, of striated muscle fibers, of glandular structures, nor of adipose tissue. There is no index. Most of the figures are good, but there are not enough to make certain of the subjects clear to beginners.

There would be no excuse for giving Mr. Beddard's zoology an extended notice were it not that the scientific prominence of its author and name of its publishers are likely to carry much weight and to lead to its introduction into American schools in the place of other and better books, and this should not happen until it has been given a thorough and radical revision.

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Laboratory Exercises in Anatomy and Physiology. By JAMES EDWARD PEABODY, A.M., Instructor in Biology in the High School for Boys and Girls, New York City. New York, Henry Holt & Co. 1898. Pp. x + 79.

In view of the large amount of instruction in physiology that is given in secondary schools and the large number of text-books that exist, it is surprising how few attempts have been made to treat the subject practically by the preparation of laboratory directions. And the few attempts, although in several cases excel-

lent, are, without exception, inadequate. The immediate cause of this state of things is probably the lack of a demand by teachers for aids of this kind; and this lack of demand is probably to be traced to a lack of realization on the part of the majority of the teachers, themselves imperfectly trained in this respect, of the advantages of the practical method. Not a few teachers, however, have longed for help in endeavoring to raise the standard of instruction in this branch from its present alcoholic and narcotic condition, and such progressive ones will heartily welcome Mr. Peabody's book.

The book is apparently intended for high-school classes. Among the subjects treated are the human and mammalian skeleton, the muscles, the chemical testing of foods, digestion, absorption, the heart, the blood and its circulation, oxidation, respiration, the skin, the kidney, excretion, touch, taste, smell, yeast and bacteria. Directions for the use of the microscope and a list of apparatus and chemicals required for the exercises are added. The book is interleaved with blank pages for notes and is intended to be placed in the hands of the pupil. The latter is given simple directions for experimenting and, instead of being told what to observe, is asked concerning the results that follow. In this respect the book is in accord with the best of the practical guides in other departments of science. "The questions * * * have been framed with the object of leading the student to seek the facts *from the material itself*. The student should be trained especially to distinguish in the experiments *observed results* from the *inferences* that may be drawn from those results." This admirable intention is well carried out. To illustrate the care with which it is done one instance may be cited. After giving directions for making and using the common bell-jar apparatus to demonstrate the action of the diaphragm and lungs, the author asks the pertinent questions: "In what respects does this model illustrate the process of inhaling and exhaling air in our own bodies? In what respects does the model fail to illustrate the process of respiration?"

The book is preeminently a guide to the study of human physiology, and a large number of the experiments and observations are to be